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Adsorption of Methylene Blue Dye from Aqueous Solutions onto Chemically Modified Apple Seeds (Malus Domestica)

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Abstract

Apple juice production belongs to the branches of industry that produce large quantities of by-products in relation to the initial amount of processed fruits. Apple seeds were collected from by-products generated during the preparation of fruit salads and in juice pressing and can be used not only as sources of bioactive compounds but also as high-cost adsorbents for purification purposes. In the present study, samples of apple seeds (A.S.) and zeolite (Z) are prepared in proportions of 100% A.S., 80%-20% A.S.-Z and 50%-50% w./w. A.S.-Z. The samples are chemically activated with HCL acid at two different concentrations of 6 and 8M. The adsorption of methylene blue dye (MB) in the above samples are studied and compared with the zeolite one (100% w./w. Z). Four different kinetic models are applied to the experimental adsorption data: pseudo-first order, pseudo-second order, Elovich and Intraparticle diffusion model. The results show that the increase in MB adsorption follows the order: zeolite > 50-50 % w./w. A.S.-Z. > 80-20 % w./w. A.S.-Z. > 100% w./w. A.S. for the adsorbents activated with HCL acid, 8M. Adsorbents activated with HCL acid of 6M present lower MB adsorption percentages ranging from 90 to 97.5% compared to the adsorbents activated with HCL of 8M. Materials, such as 50-50% w./w. A.S.-Z. activated with HCL acid of 8M have similar adsorption properties (99.4% of MB adsorption) to zeolite (99.8% of MB adsorption) but lower cost than minerals. The implementation of different kinetic models has shown that the pseudo-second order kinetic model describes better the experimental adsorption data. In conclusion, chemically activated apple seeds alone or in combination with minerals such as zeolites can be used as filters for the purification of water from organic compounds such as dyes reducing the by-product amounts released to the environment.

Keywords: apple seeds, zeolite, kinetic models, adsorption